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SUPPLEMENTAL REPORT

BIDRIN IMPLANTATION FOR WHITE-PINE CONE BEETLE CONTROL A PILOT TEST FOR NATURAL RESEEDING

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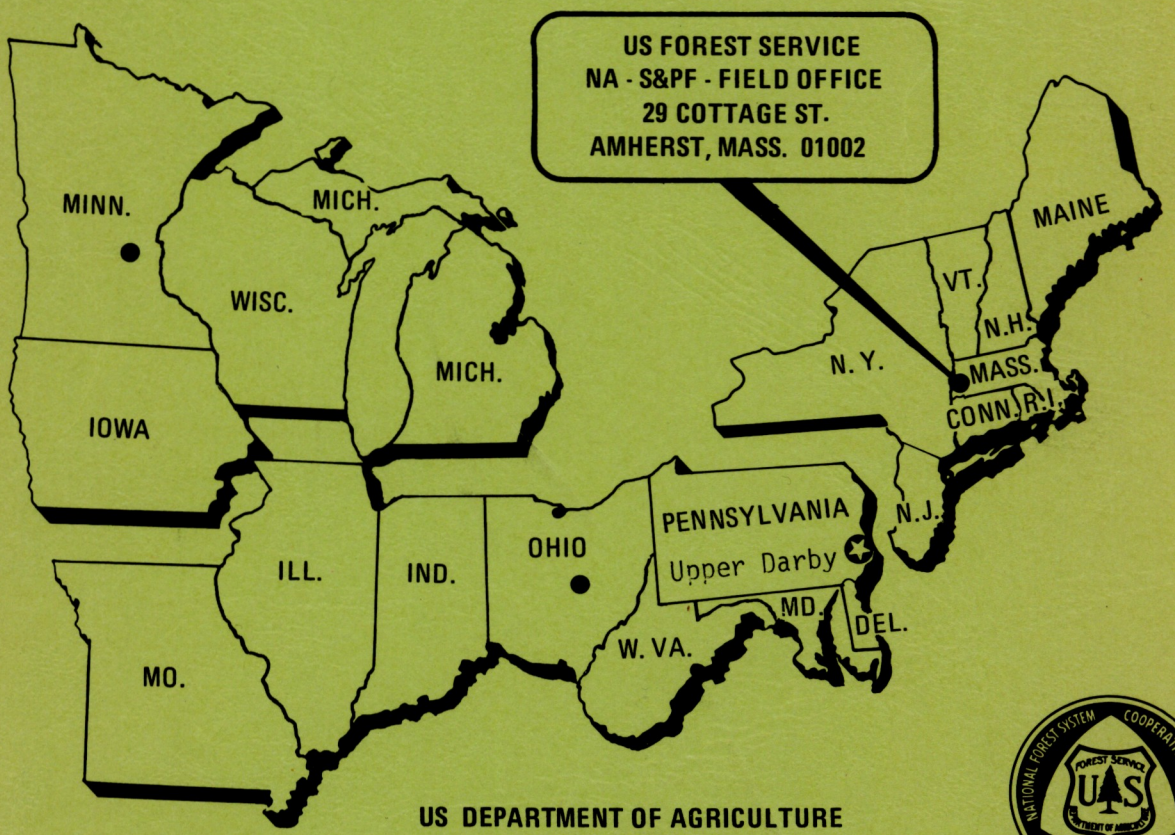

US DEPARTMENT OF AGRICULTURE
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Supplemental Report of
Bidrin Implantation for
White-Pine Cone Beetle Control
A Pilot Test for Natrual Reseeding

by

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INTRODUCTION

This report supplements the findings of Hastings and Avery (5) & (6) and concludes the study initiated by them (4).

In the original pilot test, 50 seed trees were implanted with Bidrin to control the cone beetle, Conophthorus coniperda Schwartz; and 50 trees were left untreated in a check area within the same stand. The results of cone counts demonstrated that the average percent cone survival was significantly greater for the treated trees (85.6%) than for the untreated trees (46.0%) at P=.005 (5). Additional results showed an increase in seed germination and reduced squirrel damage for treated trees (6).

The cone beetle has long been accused of sharply curtailing the re-establishment of white pine following harvest of this tree species. Hastings and Avery (4) give accounts of the destruction of cones by the beetle. The ultimate purpose in attempting to control the cone beetle in this particular instance was to obtain sufficient white pine reproduction following harvest of this species by the seed tree method. This purpose is spelled out in Management Objectives for stand #5 of the Shaker Forest. In one respect the loss of seed is academic since it is the establishment of white pine seedlings that has any practical value to the forester. The seed tree method of harvest is designed for the establishment of a new crop of desirable tree species, and not for the sole purpose of producing seed. The single objective of this test was to determine whether or not Bidrin treatment of seed trees for cone beetle control could by itself significantly increase establishment of white pine seedlings following a harvest cut. The number of beetles, cones, and seeds had little practical utility in this study. It was a test designed for use of Bidrin as a management tool, not as an experiment to determine seedbed quality, seed tree distribution or any aspect of tree physiology.

This report deals with the practical aspects of the cone beetle control test as they were originally conceived by Avery.

The work plan for this test was written by Ford (2) as a supplement to the original work plan. This supplemental plan was followed with the exception of Robert Woodward substituting for Vaughan McCowan. The supplemental plan required an analysis of variance to test for real differences between treated and untreated areas. This analysis and accompanying F test is applicable only for normal distributions. The t test, which is similar to the F test but compares two means rather than several variances, is also applicable only for data from a normally distributed population where variance is homogeneous. Rather than attempt to determine whether the seedling counts were normally distributed, the writers used non-parametric procedures

which do not require prior knowledge of the distribution. These non-parametric procedures were not anticipated in the work plan supplement, but were used after calculations indicated that the t test was invalid. This report gives data on established white pine reproduction in an area where seed trees were treated with Bidrin and compares them with data from an area in the same stand where seed trees were not treated.

METHODS

Counts of one- and two-year old white pine seedlings were made on 1/200-acre plots. There were 20 plots in the treated area and 20 plots in the untreated area. Plots were spaced one chain apart along compass lines established during initial phases of the study.

Differences between counts of seedlings on the treated and untreated portions of the stand were subjected to the unpaired t test (3). Equality of variance was determined by an F test (1) and by Wilcoxon's Test (7). A test of differences between counts was then made by Wilcoxon's Rank Sum method (7).

RESULTS

All 20 plots in the treated area were occupied by white pine seedlings. Most (95%) of the 20 plots in the check area were occupied by white pine seedlings.

The average number of white pine seedlings per plot was 52 in the treated area plots and 32 in the untreated area plots. The range was 2 to 260 and 0 to 122, respectively.

The unpaired t test ($p=.05$) showed no significant difference in the number of white pine seedlings between the treated and untreated portions of the stand. A test for equality of variance indicated that more than one population of seedlings were involved. Thus, the t test is not valid.

Wilcoxon's Rank Sum Test for differences in variability in unpaired replicates indicated the validity of applying the Rank Sum Test to the data. This latter test ($p=.05$, 1 tail) indicated no significant difference between means of seedling counts in treated and untreated areas. Calculations for these tests are shown in the Appendix.

DISCUSSION

This was a pilot test, not an experiment. Such a test implies that the procedures are conducted under conditions as they are found in the field. For example, seed trees were assumed to have been of equal quality, distribution, and size. Seed bed conditions such as soil type, amount of mineral soil exposed, and degree of exposure to sunlight were also assumed to have been equal over the entire stand. Therefore, the seed tree conditions and the seed bed conditions were not measured, evaluated, or considered for this

test since the concern was limited to what seedling establishment was under actual field conditions after a harvest cut.

Since this was a pilot test, stratification of data was not deemed necessary beyond the two classifications of treated area and untreated area.

Another assumption was that the conditions found in the stand were typical of those found in any other stand that is or will be harvested in the same manner for regeneration of white pine.

Hastings and Avery (4) indicated that the cone beetle was the major deterrent to seedling establishment. Also, Hastings and Avery (5) & (6) had shown that survival of white-pine cones increased two-fold by treatment of seed trees with Bidrin, that germination of the seed was increased, and that squirrels rejected the cones from treated trees. These findings suggested that seedling establishment in the treated area would conceivably be double that of the untreated area. In view of this we felt confident in using a simple plot design. This design was a modified random plot method long considered acceptable by foresters and forest entomologists. R. F. Morris (8) points out that "---most of the objectives of insect sampling do not require strict randomization, at least in regard to area, and the additional expense that it imposes and is therefore not always justified.". This test was in regard to seedlings on areas. Therefore, complete randomization was not absolutely necessary. Plots could be located along randomly selected lines and spaced along those lines provided no plot so selected was judged satisfactory or unsatisfactory from the surveyor's viewpoint after he looked at the plot.

The plots selected in this study were chosen in the office with the aid of a map which outlined the treated areas and the stand. No prior inspection of the stand was made to determine intensity of harvest or other forest conditions. In a sense, the plots were selected without bias. Selection of a line at least 150 feet away from another treatment area was imposed on the design to prevent overlap of seed distribution from one treatment area to another.

Some plots fell on spots that were not scarified and some fell on spots that were scarified. Seed trees were close to some plots while others were not. Site preparation in both treated and untreated areas had been carried out in the same way and apparently to the same degree.

Therefore, the null hypothesis to be tested was that there was no significant difference in seedling counts between the treated and untreated areas of the stand.

Analysis of the data indicated that there was no significant difference in seedling counts between the treated area and the untreated area. The test by Hastings and Avery (5) & (6) indicated that the cone crop was increased 85.6% by treatment with Bidrin. One would expect a similar increase in the number of seedlings established on the treated area as opposed to the untreated area. This was not the case. Hastings and Avery (6) also indicated that squirrels rejected the seed from treated trees. If squirrels took only seed from untreated trees, the catch of seedlings on the treated area could therefore be greater than on the untreated area. It was not. The lack of difference in seedling counts cannot be attributed to feeding by squirrels or cone beetles.

The average number of seedlings was 32 per plot (6400 per acre) in the untreated area. If such a catch is sufficient to meet the forester's need, there would be no reason to apply cone beetle control as a management tool.

CONCLUSION

Under the conditions of this test, white pine seedling establishment was not significantly enhanced in those areas where seed trees had been treated with Bidrin in May, 1967.

LITERATURE CITED

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(7) Wilcoxon, Frank and Roberta A. Wilcox 1964. Some rapid approximate statistical procedures. Lederle Laboratories, Pearl River, N. Y. 60 pp

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APPENDIX A.

Counts of 1-and 2-year-old white Pine seedlings on 1/200-acre plots where seed trees were implanted with Bidrin for cone beetle control on treated areas, Canterbury, New Hampshire, 1969.

Treated Area			Untreated Area		
Row	Plot	No. of White Pine Seedlings	Row	Plot	No. of White Pine Seedlings
4	1	5	9	1	10
	2	6		2	33
	3	18		3	5
	4	6		4	38
	5	7		5	15
	6	6		6	0
	7	87		7	41
	8	54		8	87
	9	16		9	28
	10	2		10	105
14	11	4	10	11	21
	12	11		12	12
	13	5		13	122
	14	60		14	10
	15	72		15	17
	16	200		16	11
	17	106		17	37
	18	260		18	11
	19	40		19	16
	20	86		20	22

APPENDIX B

Calculation of t Test for differences between counts of white pine seedlings on Bidrin treated and untreated areas, cone beetle suppression. Canterbury, New Hampshire 1969.

Treated — Sum = 1051 — Mean = 52.55 — N = 20

$$SS_T = 148{,}029 - \frac{1104601}{20} = 4884.16$$

Untreated — Sum = 641 — Mean = 32.05 — N = 20

$$SS_U = 42151 - \frac{410881}{20} = 1137.21$$

$$s^2 = \frac{4884.16 + 1137.21}{\text{d.f.} = 38} = 3010.68$$

$$t = \frac{52.55 - 32.05}{\sqrt{3010.68\ \frac{(40)}{400}}} = 1.18 \text{ not significant}$$

Table $t_{.05} = 2.02$

APPENDIX C

Calculations to determine the equality of variance of white pine seedling counts in an untreated area and area treated with Bidrin for control of cone beetle. Canterbury, New Hampshire 1969.

$S_T^2 = 4884.16/19 = 257.06$

$S_u^2 = 1137.21/19 = 59.85$

$\frac{S_T^2}{S_u^2} = 4.29 = F$

Table $F_{.05}(19,19) = 2.10$

Since $F = 4.29 >$ Table $F = 2.10$,

$S_T^2 \neq S_u^2$ at 10% level of significance

APPENDIX D

Test of the difference in variability by Wilcoxon's method showing a wide variability between counts of white pine seedlings on untreated and Bidrin treated areas, cone beetle control test. Canterbury, New Hampshire 1969

Treatment	No. of Trees	Rank	Treatment	No. of Trees	Rank
U	0	1	T	18	39
T	2	4	U	21	38
T	4	5	U	22	35
T	5	9.7	U	28	34
T	5	9.7	U	33	31
U	5	9.7	U	37	30
T	6	15.3	U	38	27
T	6	15.3	T	40	26
T	6	15.3	U	41	23
T	7	20	T	54	22
U	10	22.5	T	60	19
U	10	22.5	T	72	18
T	11	27.3	T	86	15
U	11	27.3	T	87	12.5
U	11	27.3	U	87	12.5
U	12	32	U	105	10
U	15	33	T	106	7
T	16	36.5	T	200	6
U	16	36.5	U	122	3
U	17	40	T	260	2

Untreated Sum, U = 495.3

Treated Sum, T = 324.6

Table Values 349; 471

5% probability level

APPENDIX E

Conclude that the means of the two counts do not differ significantly. Test for the difference in means between counts of white pine seedlings in untreated and Bidrin treated areas. Cone beetle control test, Canterbury, New Hampshire 1969.

Treated Area (T)		Untreated Area (U)	
No. Of Seedlings	Rank	No. of Seedlings	Rank
2	2	0	1
4	3	5	5
5	5	10	11.5
5	5	10	11.5
6	8	11	14
6	8	11	14
6	8	12	16
7	10	15	17
11	14	16	18.5
16	18.5	17	20
18	21	21	22
40	28	22	23
54	30	28	24
60	31	33	25
72	32	37	26
86	33	38	27
87	34.5	41	29
106	37	87	34.5
200	39	105	36
260	40	122	38
Sum	407	Sum	418

Table value 349
P = .05

Table value 471
P = .05